

ONE-GROUP PRE-POST DESIGN

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Primary Disciplinary Field(s): Psychology, Statistics, Education, Social Sciences Research

1. Core Definition

The **One-Group Pre-Post Design**, sometimes referred to as the Pretest-Posttest Design without a control group, is a foundational, yet methodologically weak, quasi-experimental research setup used primarily in the social and behavioral sciences. It involves measuring a dependent variable (the outcome) in a single group of participants *before* (the pretest or baseline measurement) and *after* (the posttest) they have been exposed to a specific treatment, intervention, or remediation. The fundamental goal is to determine if the intervention caused a change in the measured outcome. The supposed effect of the treatment is simply the difference between the posttest scores and the pretest scores. While straightforward to implement, this design provides limited causal inference because it lacks the necessary comparison group (a control group) and random assignment, making it highly susceptible to numerous threats to internal validity.

The simplicity of the design makes it appealing for preliminary or pilot studies, particularly in applied settings where ethical or logistical constraints prevent the formation of a true control group, such as in certain educational or clinical trials where withholding treatment might be deemed unethical. However, academic consensus strongly cautions against relying on the findings generated by this method for establishing strong evidence of causality. Researchers utilizing this structure are often left, as the source content suggests, "wondering if the results were reliable," because any observed change cannot be definitively attributed to the intervention itself, but rather to a host of confounding factors operating simultaneously.

2. Etymology and Historical Development

The roots of experimental design, including early iterations of the pre-post structure, trace back to the mid-20th century, following the foundational work of statisticians like Sir Ronald Fisher, who championed the principles of randomization and control groups in agricultural and later, behavioral research. The **one-group pre-post design** emerged as a pragmatic adaptation in fields--like educational psychology and clinical intervention--where true experimental control was often difficult or impossible to achieve outside of strictly controlled laboratory settings. It represents one of the earliest forms of quantifying change over time relative to an intervention.

The design's structure predates the widespread acceptance of rigorous experimental standards, particularly the standards outlined by Donald Campbell and Julian Stanley in their seminal 1963 monograph, "Experimental and Quasi-Experimental Designs for Research." Campbell and Stanley rigorously cataloged the weaknesses of various designs, specifically categorizing the one-group pretest-posttest design as a "pre-experimental design." This classification signaled that, while

useful for exploratory purposes, it fails to meet the minimum standards required to confidently infer a cause-and-effect relationship. Their work fundamentally shifted the perception of this design from a potentially useful method to one primarily used to illustrate the potential pitfalls of inadequate research methodology.

3. Key Components and Operationalization

The operational structure of the **One-Group Pre-Post Design** is exceptionally sparse, involving just three core steps executed on a single cohort of participants:

The Pretest (O1): The measurement of the dependent variable before the intervention. This establishes the baseline performance or state of the group.

The Treatment (X): The application of the independent variable or intervention. This is the factor hypothesized to cause change.

The Posttest (O2): The measurement of the dependent variable again, after the treatment has been applied.

The treatment effect is mathematically calculated as the difference: $E = O2 - O1$. A significant non-zero difference is interpreted by the researcher as the effect of the treatment. However, the critical flaw lies in the inability to determine what proportion of that difference is truly attributable to X, versus what is attributable to uncontrolled environmental, biological, or psychological factors that occurred naturally between O1 and O2. The lack of a counterfactual--what would have happened without the intervention--renders the causal claim weak.

4. Threats to Internal Validity

The primary academic significance of studying the **One-Group Pre-Post Design** lies in its utility as a pedagogical tool for understanding and avoiding threats to internal validity. Internal validity refers to the extent to which one can confidently conclude that the observed change in the dependent variable was caused solely by the independent variable. In this design, there are multiple competing explanations for the O2 - O1 difference:

History: External events occurring between the pretest and posttest that are unrelated to the treatment but influence the outcome. For instance, if a new educational policy is implemented during the intervention period of a teaching efficacy study, improvements might be due to the policy, not the specific program being tested.

Maturation: Changes within the participants themselves that occur naturally over time, such as physical growth, aging, increased experience, or simple fatigue. This is particularly salient in studies involving children or long-term interventions.

Testing: The effect of taking the pretest itself influencing the posttest scores. Participants might become sensitized to the test content, learn the test structure, or remember their answers, leading

to improved scores regardless of the treatment.

Instrumentation: Changes in the measurement tool or procedure over time. This could involve drift in scoring criteria if human observers are used, or calibration issues if mechanical instruments are involved. If the posttest is easier or scored differently than the pretest, the change is spurious.

Regression to the Mean: A statistical phenomenon where extreme scores (very high or very low) on the pretest tend to move closer to the group mean on the posttest, simply due to random variation or measurement error. If an intervention specifically targets individuals who scored poorly (extremely low) on the pretest, their subsequent improvement is often misinterpreted as a treatment effect when it is merely statistical regression.

Mortality (Attrition): The loss of participants from the study between the pretest and posttest. If the participants who drop out differ systematically from those who remain (e.g., only the most engaged or the least successful stay), the remaining group is no longer representative, biasing the final results.

These threats are not merely theoretical; they are extremely likely to manifest, especially in real-world settings, thereby rendering the interpretation of results highly ambiguous. The only way to control for these internal threats is through the inclusion of a control group that experiences everything the treatment group does, except the actual intervention (X).

5. Practical Applications and Use Cases

Despite its severe methodological limitations, the **One-Group Pre-Post Design** retains some practical utility when strong causal inference is not the primary objective. It is most often employed in situations demanding convenience, low cost, or preliminary data collection:

Program Evaluation (Formative): Before launching a full-scale, expensive Randomized Controlled Trial (RCT), researchers may use this design to quickly assess feasibility, acceptability, and initial gross effectiveness. If no change is observed in the pre-post scores, the intervention is likely ineffective and development can cease.

Pilot Studies: Gathering preliminary data to estimate effect size for calculating the necessary sample size for a subsequent, more rigorous study.

Logistical Constraints: In settings where randomization is politically or ethically infeasible (e.g., evaluating a new curriculum applied universally across a small school district), this design may be the only option available. However, researchers must be highly cautious when interpreting these findings and clearly state the limitations.

Demonstration Projects: Used primarily for descriptive purposes to illustrate that change occurred, without necessarily proving the intervention caused the change. For example, demonstrating that students improved their test scores after a new tutoring program, even if the improvement might be due to normal maturation.

In these applications, the design acts as a simple monitoring tool rather than a definitive causal assessment tool. Researchers must rely heavily on qualitative data and logical arguments (i.e., ruling out obvious historical events) to support any interpretation of the observed change.

6. Comparison with Superior Designs

The weaknesses inherent in the One-Group Pre-Post Design highlight the necessity of employing more robust experimental or quasi-experimental alternatives whenever possible. The ideal solution is the Randomized Controlled Trial (RCT), but several quasi-experimental designs offer significant improvements over the one-group design:

Pretest-Posttest Control Group Design (True Experiment): This involves two groups (treatment and control), both measured at O1 and O2. Participants are randomly assigned. This controls for all major internal threats (History, Maturation, Testing, Instrumentation, and Regression) because both groups experience these factors equally, allowing the net difference between the groups to be attributed confidently to the treatment.

Nonequivalent Control Group Design (Quasi-Experiment): Similar to the true experiment, but participants are not randomly assigned to groups (e.g., using two existing classes or departments). While weaker than an RCT due to potential selection bias, it significantly improves internal validity over the one-group design by providing a counterfactual.

Time Series Design (Quasi-Experiment): This involves multiple measurements taken both before and after the intervention (O1 O2 O3 O4 X O5 O6 O7 O8). By observing the pattern of scores before the treatment (the baseline trend), researchers can better differentiate a true treatment effect (a sudden, sustained deviation from the trend) from natural maturation or regression.

These superior designs illustrate that control is the essence of strong research methodology. The inclusion of a comparison group or repeated baseline observations transforms the interpretation from "Did change occur?" to the far more critical question: "Did the treatment cause significantly more change than would have occurred naturally or without the intervention?"

7. Conclusion and Modern Utility

In modern research methodology, the **One-Group Pre-Post Design** serves primarily as an object lesson in experimental fallacy rather than a recommended methodology for hypothesis testing. Its continued use is often justified by practical limitations rather than methodological preference. Researchers must understand that while a significant difference between O1 and O2 may exist, this statistical significance does not equate to causal validity.

For any study aiming to make claims about effectiveness or causality (i.e., proving that Intervention X works), this design must be avoided. Its main contribution to the field is pedagogical, highlighting the necessity of rigorous control and comparison groups to isolate the true effect of an independent

variable from the myriad of extraneous variables inherent in any longitudinal study involving human participants.

Further Reading

[Pretest-posttest design \(Wikipedia\)](#)

[Internal Validity \(Wikipedia\)](#)

[Quasi-Experimental Designs \(Social Research Methods\)](#)

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